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GEOLOGIC ANTIQUITY OF MAN IN AMERICA[1]

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THE PROBLEM

THE Europeans who first explored the Americas found in this "New World" numerous tribes of dark-skinned, black-haired people. They differed in dress, habits and social organization, but all of them lived by agriculture or by a combination of agriculture, food-gathering, hunting and fishing. Only a few tribes were solely dependent on hunting, and most of them were in touch by trade with agricultural groups. These cultural similarities and a common physiognomy led to the popular recognition of these newly found people as a separate race, the Red or American. More detailed scientific study has shown that these peoples are much more diverse in physical and cultural attributes than was at first supposed. It is clear that there has been an intimate blending of racial strains. One must suppose that these people, descended from whatever diverse stocks, have a long common history.

From the beginning of exploration also the question of the origin has been posed. As the people of the Americas are obviously not closely related to the peoples of western Europe their origin by migration across the Atlantic has been rejected except by advocates of the myth of Atlantis. The Mongolian strain clearly marked in many American tribes and the narrow seas of Bering Strait point to migration from Asia. Most of the immigrants must have crossed on foot either on the ice north of the strait[2] or on a land bridge produced by the lowered sea level of glacial

[1] Address of the retiring vice-president and chairman of the Section on Geology and Geography of the American Association for the Advancement of Science, Philadelphia, December 27, 1940.

[2] P. S. Smith, "Certain Relations between North-western America and North-eastern Asia: Early Man," pp. 85–9[illegible]. Ed. by G. G. McCurdy. Philadelphia, 1937.

time. No one can deny the possibility of travel in boats. There are several possible routes: (1) across Bering Straits; (2) across the sea from Kamchatka to the Aleutian Islands; (3) across the northern Pacific on the Japanese Current; (4) across the southern Pacific from Oceanica. It is obvious, however, that the longer boat journeys and even the narrow waters of Bering Strait could have been available only to people of a sufficiently advanced culture to have the requisite boats. Large numbers of primitives could only have reached the Americas by the ice route or during periods when there was a land connection in the area of Bering Strait. During glacial times the level of the sea was lowered (85 m. in the last stage, and 105 m. at the maximum), and at such times Bering Strait would have been largely dry land. In fact Smith[3] believes on the basis of existing surveys that a course could be laid out that would be dry land with a lowering of sea level of only 40 m.

Further, the central part of Alaska and a large part of the Mackenzie Basin were free of ice during the whole of the Pleistocene. An entrance into Alaska and residence there was possible at any time by people adapted to life in an Arctic and near-Arctic environment.

The passage southward is more difficult. The coast route along the chain of fjords and islands of southern Alaska and British Columbia is narrow at best and requires both a specialized fishing culture for survival and the use of boats for movement. The plains route east of the Rocky Mountains must have been blocked by ice during periods of glaciation. It was always and is, even yet, a harsh environment requiring for survival a specialized hunting technique.

These geographic relations imply that the peopling of America occurred largely if not exclusively by migration from northeastern Siberia across ice or land in the Bering Strait region to Alaska and thence south. Entrance into Alaska would have been easier during glacial stages when sea level was low. Movement southward would have been easy only after the climax of each glacial stage when the Canadian plains were free of ice. One could imagine successive pulsations by which people entered in glacial intervals and were trapped for a considerable time in Alaska and in the Mackenzie basin by the rising sea level of interglacial time. Thereafter they were permitted to filter south as the ice dam in the Plains disappeared about 10,000 years after the glacial maximum. In the absence of archeological data such an idea is intriguing, but perhaps fanciful. The crossing of the straits and the passage southward may both have occurred in the relatively genial climate of interglacial and interstadial times. Even in such periods Alaska would have had a climate not much warmer than at present. Whatever the original culture, the migrants must have adapted themselves to specialized hunting and fishing as a livelihood. The longer the period of migration the less the memory of any postulated homeland or of any previous method of livelihood. Only those traits of the original culture which could be easily used or retained by a hunting-fishing people in a cold environment would survive. On this line of reasoning the present cultural characteristics of the peoples of North and South America must be regarded as largely a new development. Even hunting cultures must have been much modified by movement into the warmer south and the change in economy with change in fauna. The possibility that the survivors of shipwrecked Chinese junks or wide-ranging Polynesian canoes may have brought in cultural ideas must be recognized. There is, however, little tangible basis for postulating these recruits to America. At best they must have been late comers without possibility of influence on the earlier phases of New World cultural development.

In the foregoing, the difficulties of the route have been emphasized. To the relatively advanced and well-organized tribes developed in Asia in the past 2,000 to 4,000 years, many of the difficulties would be small. In proportion to their cohesion and adaptability, such tribes may have made much more rapid progress than the earlier people.

Not only does the preponderance of evidence imply a single migration route into the New World, but it was essentially a one-way road. Those who crossed to Alaska could easily cross back as environmental differences are small. Those who once went southward into the broad spaces of the American continent changed their habits, and thus built an environmental wall behind them. Whether in time, the expansion of population in the south might have set up a counter pressure and might thus have forced a retracing of the route is an interesting speculation. It is, however, beside the point. The early comers found empty the expanses of two great continents, and for them there was no inducement to backtrack.

The route of entry and the type of culture necessary for the journey as outlined above have long been parts of the established doctrine of American anthropology. The date of entry has, however, been much disputed. The American Indian at the time of the Conquest was largely agricultural, acquainted with pottery and in some localities semi-civilized. Even the hunting and fishing tribes had a typical "Neolithic" stone industry.

As shown by many archeologic excavations, their immediate predecessors were like them in general aspect. Arguing from these facts most anthropologists have, up to a few years ago, held that the American Indian is a recent immigrant. From time to time finds were

[3] P. S. Smith, *op. cit.*, p. 89.

made to which a greater antiquity was attributed. Some were without merit; others in spite of merit were decried as merely the result of mistaken zeal.

The possibility of greater antiquity for the inhabitants of the New World was placed in a different light by the finding in 1927 near Folsom, New Mexico, of fluted points of a distinct type, indubitably associated with the bones of extinct bison. In the past thirteen years there has been much activity and many localities have been found at which artifacts and the bones of extinct animals are known.[4] Besides the fluted points other stone tools and various bone artifacts are now the recognized components of the Folsom culture.[5] Other stone cultures differing from the normal types of the American Indian have been described.[6] These obviously earlier cultures have been grouped under the name "Paleo-Indian" by Roberts.[7]

It is obvious that the question of the antiquity of man in the New World has been narrowed down. Whereas previous to 1927 the question rested on an almost entirely hypothetical basis, the accumulation of new data is now so great that there is a solid, if still meager, framework of fact. We are no longer asking the question: What is the antiquity of the American Indian, but What is the antiquity of the Paleo-Indian?

Furthermore, the advance of knowledge made in the Old World in the relation of human races and cultures to the chronology of the Pleistocene has provided a sound theoretical basis for the interpretation of our new-found facts. Many archeologists and geologists aided by a host of amateurs in both sciences are engaged in adding to our data and to our interpretations. The rate of progress is accelerating. All this material is valuable, but much of it is so newly acquired that it has not yet been evaluated. I shall, therefore, speak only of those localities and those cultures which seem at the moment to have the greatest value as guideposts on an inquiry into antiquity. Many of the data not mentioned may yet prove more important than they seem at present, as relative values change in a rapidly advancing subject.

Lines of Approach

The question of antiquity may be attacked from several view-points, each in itself valuable. At the moment the several lines of approach, with the exception of the geological, are largely inconclusive. They are important on the negative but not on the positive. Each is here summarized briefly and all too inadequately.

Physical anthropology. The inhabitants of the New World are a blended mixture of races of *Homo sapiens* in which the Mongolian is prominent and in many tribes dominant. This blending implies either a long occupance of the New World by originally distinct races or a mixture in the Old World previous to migration or both.

All known skeletons are those of modern man or *Homo sapiens.* The lack of more primitive types such as the Neanderthal has often been used as an argument that man is a newcomer to these continents. However, new finds in England establish *Homo sapiens* as living in that country as early as the second interglacial.[8] Modern man has thus a very respectable antiquity. Neanderthaloid characters are unnecessary requirements for immigrants to North America if they are to arrive in the latter part of the Pleistocene.

The skeletal finds which have some claim to antiquity have a general likeness. All are long-headed and heavy-featured and thus resemble the Europeans of the time of the advance and recession[9] of the last ice. Similar physical types are not unknown among the modern Indians, but are most common in small tribes on the periphery of the two continents. These people may be the relatively unchanged descendants of the earliest migrants.

Thus the present data of physical anthropology can be interpreted to permit a Pleistocene antiquity of man in the New World, but these data lend no confirmatory proof.

Association with extinct animals. The earlier view that animals now extinct lived in the Pleistocene and that the presence of the modern fauna is proof of Recent or post-Pleistocene time was strongly supported by Hay[10] and others. These ideas have been largely abandoned. Most vertebrate paleontologists[11] concede that the now extinct vertebrates may have survived to within a very short time ago. Furthermore, it is at present impossible to assign any given extinct fauna to any one phase of the Late Pleistocene or Recent. The stratigraphic evidence is at the moment too imperfect, although hope burns bright for the future.

American cultivated plants and agriculture. The plants cultivated by the pre-Columbian inhabitants of the New World have a strictly new world origin.

[4] E. H. Sellards, *Geol. Soc. Amer. Bull.*, 51: 373–432, 1940.

[5] Frank H. H. Roberts, Jr., *Smithson. Misc. Coll.*, 94: 4, 1935, and 95: 10, 1936. Ann Rept. for 1938, Smithson. Inst., pp. 531–546.

[6] Helen Marie Wormington [Volk]. Colo. Mus. Nat. Hist., Popular Ser. No. 4, 1939 (discussion and references to original papers).

[7] Frank H. H. Roberts, Jr., *Smithson. Misc. Coll.*, 100 (Swanton vol.): 51–116, 1940.

[8] E. A. Hooton, "Why Men Behave Like Apes and Vice Versa," pp. 78–80, 1940. (Summary statement). Committee Report: *Jour. Roy. Arch. Inst.*, 67: 17–98, 1938. T. T. Paterson, *Proc. Prehist. Soc.*, pp. 166–169, 1940.

[9] E. A. Hooton, *op. cit.*, p. 134.

[10] O. P. Hay, Carnegie Inst. Wash. Publ. No. 322, 1923–27.

[11] A. S. Romer, 5th Pac. Sci. Congr. Canada, pp. 47–83, 1933.

Many of these plants, of which maize is the prime example, have been so modified by man that the wild progenitor has been eliminated. They have become "cultogens" dependent on man for survival. Furthermore, American agriculture in "hills" is quite different from the "broadcasting" of Euro-Asiatic agriculture. All botanical authorities on the American "cultogens" agree that a long time is necessary to select and develop the plants, and, as Ames insists, to invent and perfect the agricultural practices of the New World.[12] How long this period may have been can not be closely estimated by botanical methods. If the period of migration over the tundra of Siberia and Alaska was a long one, the immigrants may be supposed to have entered North America without knowledge of any southern flora. On this line of reasoning, their intimate knowledge of the New World flora and their successful breeding of agricultural plants was a wholly new development. It is a fair inference that the time required was as long as the time required to develop Old World agriculture. In both areas also a very long preliminary stage in which food gathering and the hunting of medicinal plants yielded an intimate knowledge of the flora must be inferred.

Archeology. The principle that types of stone tools, however simple and primitive, are characteristic of certain cultures and therefore that they are criteria of the time interval when these cultures flourished has been widely accepted. In France and England long study and much correlation with geologic events has proved that hand axes and the Levallois, Clactonian and Mousterian flake types are characteristic of the Pleistocene at various intervals from the first interglacial to the first part of the fourth glacial. Recent work has shown that in the Middle Pleistocene there was in Asia over a great triangle from the Indies to Java and north to Peking in China a characteristic chopping-tool industry.[13] This technique, different from that of Europe, influenced the forms developed in Asia in the fourth glacial stage.

Thus the typology of stone tools successfully established as a chronologic sequence in Europe is not applicable to the world as a whole. Also the absence of typically European implements in the New World is to be expected. It appears much more likely that the immigrants from Asia would have imported the stone techniques of eastern Asia. Our knowledge of these stone cultures does not extend into the area of northeastern Asia from which migrations must have started. Consequently at the present time there can be no tr comparison between New and Old World stone cultur except on the broadest basis.

Typology can be used on the negative. As the u of pressure flaking either along with or in combinatio with percussion flaking did not come into use i Europe or as far as known in Asia until the lat part of the last glacial stage, this technique should n be much earlier in the New World. The New Wor cultures having the greatest claims to antiquity are i part of the pressure flaking type. For them there i a limit of antiquity. They should not be older th the later part of the last ice age. Even this reserv tion is, however, not absolute as the area of nort eastern Siberia from which migration is presumed t have occurred is unexplored archeologically.

Geology. The geological method of determinin antiquity is full of pitfalls and blind alleys. It is, a the moment, the only available method. In the futur the other methods, heretofore reviewed, will be mor valuable than at present, and will become supportin and additional aids. For complete success of the geo logic method a detailed and comprehensive knowledg of the chronology of the Pleistocene such as we do no yet possess, is required. The presence of the relic of man in "geologic" deposits is, however, an enormo stimulus to research. The Europeans by the clos integration of archeological and geological work hav of late years acquired a knowledge of the Pleistocen truly amazing in its relative perfection. This stim lus, long denied, we now have, and an eager searc for new facts, new criteria and new data in glaciate and unglaciated areas is in progress.

The Geologic Method

The geologic method of attack on the antiquity o man may be carried to successful completion onl under a combination of circumstances not always avai able. An archeological site must meet four require ments: (1) the relics of man or his culture must b associated with a definite bed or beds; (2) these bed must be related to some definite and local geologi event; (3) this event must be related to other event over a large area or must itself have wide geographi extent; (4) these events or these sequences of event must also be related to some geologic chronology.

A single implement or even a skeleton found unde the best of auspices has only moderate value. It i too easy to challenge its provenance. The publicity seeking exploiters of such finds meet their match in a group of professional challengers of great skill an ingenuity. The "site" valuable for geologic dating i one that produces archeological objects repeatedly The association with a given bed or "horizon" is thu indubitable because subject to repeated proof. Th

[12] Oakes Ames, "Economic Annuals and Human Cultures," Harvard Univ. Bot. Museum, 153 pp., 1939. E. D. Merrill, "Domesticated Plants in Relation to the Diffusion of Culture: Early Man," pp. 277–284. Ed. by G. G. McCurdy. Philadelphia, 1937.

[13] H. L. Movius, Jr., *Peabody Mus. Bull.* (in preparation).

peated production of relics implies that the site has en excavated by an archeologist or several archeolo-ts of skill and devotion.

From this "site," which is a restricted locality, the d or "horizon" must be traced and related to a local logic event such as the building of a valley floor, w perhaps a terrace, the existence of a lake, now ained or dried up, the movement of a glacier, long ce dissipated. The local event, however interesting itself, may give little clue to the date of the deposit. may, however, furnish the basis for a qualitative dgment that there is a material degree of antiquity. less this local event can be related to other events d these in turn can be related to still other events er a wide area it is unlikely that a more definite swer to the question of antiquity can be given. The itations of a purely local incident are best shown the deposits of caves. There may exist an easily monstrated sequence of events within the cave, but ere is ordinarily little chance of a direct physical nnection between any one of the deposits in the cave d the deposits produced by geologic processes out-le the cave. Thus the cave sequence may be unique. it is to be related to events in the world outside ere must be a cross-dating by means of the cultural the paleontological contents of one or more of the ve deposits. By whatever means the local sequence events is extended, it is obvious that the greater the ea the greater the opportunity for critical contact ith established geologic chronologies.

Unfortunately also the history of the Pleistocene ust be built up from many diverse lines of evidence d by unlike methods of work. In some localities ere are marine and fresh-water beds so that the study primarily stratigraphic and paleontological. In her localities the deposits of glaciers afford the evi-nce. The study of such deposits is by a combination methods. In still other places all the events of the eriod are erosional and the study is exclusively geo-rphic. To bring these several chronologies into der and into agreement with each other requires me unifying principle. Fortunately this principle ists in the climatic rhythm characteristic of the leistocene.

The Climatic Rhythm of the Pleistocene

One of the great triumphs of the science of geology the detection and analysis of the relics of ancient aciation. Furthermore, these ancient glaciers ad-nced more than once, and wherever adequate work as been done four glacial stages separated by time tervals marked by warm climate have been found. his four-fold subdivision of the glacial period is quite enerally accepted for Europe and North America. ery active work in Europe in recent years has rought into prominence the view that the glacial stages are multiple and that each consists of at least two ice advances separated by intervals of ameliorated climate warmer than the present.[14]

This idea is best supported for the last or Wisconsin glacial period. It appears both in Europe and America to have been divided into at least three main substages of ice advance separated by two interstadial periods of climate warmer than the present but not so warm as the interglacial stages.

Unfortunately, there is no absolute proof that glaciation was synchronous over the earth. The synchroneity is at best a doctrine supported by: (1) the similarity in the number and apparent length of the glacial stages and the interglacial stages between them; (2) the general similarity in the amount of weathering and erosion suffered by glacial deposits of corresponding age; (3) the similarity throughout the interval of the changes in the animals and in man. These arguments when set down seem weak indeed. On the other hand, there is no valid argument to the contrary. Furthermore, for the last or Wisconsin period the parallelism of events appears to be so close that a common cause operating simultaneously appears to be the only reasonable explanation.

Many of these objections to synchroneity would seem less formidable if the cause of the glacial periods were known. On this question there is no agreement, and it may well be that the glacial period is polygenetic in origin. But even if origin by the cooperation of diverse causes is granted, it is also true that the mere existence of great ice sheets would induce world-wide changes in climate.[15] It is therefore possible to assume that, at the time of ice advance, there were general changes in climate, even if we are ignorant of the fundamental causes behind the initial formation of the ice sheets.

There have been many studies of the phenomena of the glacial period in areas outside of those directly affected by the ice. The concurrent eustatic fluctuations of the sea, the phenomena of intensive frost action, sand dunes and loess deposition in periglacial areas, the rise of lake levels, the terraces on rivers and the changes in flora and fauna—all phenomena connected with the inferred general changes in climate of the ice age have received attention. In these phenomena and in the possibility of building a chain of argument from an artifact-bearing horizon through them to the climatic rhythm rests the hope of a geologic date.

If these phenomena had been more intensively studied, if local chronologies had already been built up, the task would be easier. Unfortunately it is

[14] F. E. Zeuner, *Geol. Mag.*, 72: 350–376, 1935. Wolfgang Soergel, *Fortschr. Geol. und Pal.*, Vol. 13, 251 pp. 1925. Die Vereisungskurve, Gebrüder Borntraeger, Berlin.

[15] C. E. P. Brooks, "Climate through the Ages," 436 pp. 1926.

necessary to discover and to test each of these types of evidence. Each must be placed in the climatic rhythm, before it is valuable for the purpose. Here the stimulus of archeologic importance blows as a fresh breeze impelling workers to an intensity of effort heretofore lacking.

The Dating of Ancient Cultures

In the foregoing the requisite anthropological and geological theory has been reviewed. The practical task of reaching a conclusion as to the date of an ancient culture rests on the assumption that these theories are sound. Recapitulated they are: (1) Man entered the New World by way of Bering Strait and had the cultural characteristics thereby engendered. (2) During times of glacial advance, sea level was lowered and entrance into Alaska easier, but the route southward was blocked by ice. (3) During interglacial or interstadial times it was harder to reach Alaska but easier to advance into the more genial heart of the Continent. (4) Glaciation was synchronous over the world. (5) The rhythmic fluctuations of the glacial ice are related to or themselves produced concurrent climatic changes which affected the level of enclosed lakes, the régime of streams and left other identifiable traces. (6) There were also concurrent changes in vegetation and in animal life which affected the distribution and economy of mankind and thereby his culture.

Consciously or unconsciously, investigation of and, more particularly, the dating of early man rests on the assumption that these theories or doctrines are true. The investigations test and retest these theories. There is thus a constant and accelerating advance by which hypothesis becomes theory, and theory becomes doctrine.

The Antiquity of the Folsom Culture[16]

The long-continued excavation of the Lindenmeier site in Colorado has afforded a suite of artifacts from which the Folsom culture can be defined.[17] Here the characteristic fluted points and many other types of implements are found in a dark bed overlying eroded white tuff. The bed forms the floor of an old and almost abandoned valley preserved by reason of a remarkable series of stream captures. From time to time it has formed part of one or another tributary of Cache le Poudre River some 30 miles away. Local details demonstrate that the artifact-bearing old valley floor is the equivalent of the 30-foot or Kersey terrace on the main river.

Thus the Lindenmeier site fulfils the requirements of datability. There is a large artifact-bearing horizon which is related to a local event, the existence of this old valley floor. The old valley is of the same age as the Kersey terrace, an abandoned grade not only of the Cache le Poudre but of the South Platte drainage. Associated with the Kersey terrace on the South Platte near Kersey and at Dent are Folsom sites. These sites in themselves are not important and the facts concerning them not completely recorded. Their existence, however, confirms the geomorphic correlation between the valley floor at Lindenmeier and the Kersey terrace.

The Cache le Poudre and South Platte Rivers rise in the Southern Rocky mountains where even yet small glaciers exist. These mountains had much larger glaciers in the past. The Kersey terrace has been traced up the Cache le Poudre to the Corral Creek moraine. It is the outwash plain of this glacial substage. Thus by a geologic linkage the Folsom culture is of glacial age, but to which substage in the general chronology does it belong?

The Wisconsin ice advanced three times in the Southern Rocky Mountains.[18] Each advance left a moraine in the canyon floors and each was followed by a complete withdrawal of the ice before a new advance ensued. Three sets of moraines were built, the Twin Lakes, Home and Corral Creek. There was also a fourth readvance or slight pause in retreat, the Long Draw, and a later period of refrigeration, the Sprague. These newly won data on glaciation in these mountains can be correlated with Wisconsin events in continental United States and in Europe as shown in Table I:

[16] Based on Kirk Bryan and Louis L. Ray, *Smithson. Misc. Coll.*, 99: 2, 76 pp., 1940.

[17] Frank H. H. Roberts, Jr., *Smithson. Misc. Coll.*, 94: 4, 1935; 95: 10, 1936. Ann. Rpt. for 1938, Smithson. Inst., pp. 531–546, 1939.

[18] Louis L. Ray, *Geol. Soc. Amer. Bull.*, 51: 1851–1918, 1940.

TABLE I

CORRELATION AND DATING OF THE FOLSOM CULTURE

Short Designation	Terraces	Southern Rocky Mountains	North American Continental Substages	European Continental Substages	Date in Years
	Absent	Sprague (Protalus Rampart)	?	?	
W4	Kuner	Long Draw	Cochrane?	Fennoscandian	10,000 ±
W3	Kersey	Corral Creek	Mankato	Pomeranian	25,000 ±
W2	Pleasant Valley	Home	Tazewell-Cary	Weichsel	?
W1	Pleasant Valley	Twin Lakes	Iowan	Wärthe	?

There is no physical connection between the glacial deposits of the Southern Rockies and the deposits of the continental glaciers of the Middle West. It would be possible to trace the glacial deposits of the Northern Rockies directly into the deposits of the continental glaciers, but this task is as yet incompletely done. Even if it were accomplished there would still be a gap across the Wyoming basin between the Southern and Northern Rockies. A correlation must therefore be made by a mental leap of more than a thousand miles. It rests on a general argument that the number of stages is the same and that the general state of weathering of the deposits of each of the stages is comparable. Weak as such an argument may be, it is the best that we can do in the absence of confirmation by paleontological or archeological cross-dating.

With this correlation it is possible to make a similar leap over 3,000 miles of ocean to Europe and correlate with the European chronology. The correlation of the Mankato with the Pomeranian stage has long been made, and detailed consideration has been given by Antevs[19] to the accordance in geochronological dating. Armed with his data we can say with some assurance that the Pomeranian ice advance and therefore that of the Mankato and the Corral Creek stages occurred about 25,000 years before our time.

The culture layer at Lindenmeier presumably represents the time just after the maximum, as it corresponds to the top of the Kersey terrace. Thus the date of the Folsom culture is just after 25,000 ± years ago. The data present no limitation as to time of the beginning or the end of this culture, except that Roberts[20] reports the finding of two Yuma or Yuma-like points in the rubble above the main Folsom horizon at Lindenmeier. As this rubble appears to have been deposited after the floor of the Lindenmeier Valley became dry, it is later than the climax of the Corral Creek stage. How much later there is no means of determining.

Antiquity of the Sandia Culture

To the enterprise and skill of Dr. Frank C. Hibben we owe the discovery of the Sandia Cave.[21] Here there is complete and incontrovertible evidence of a pre-Folsom culture.

The cave consists of a tunnel-like opening on the east wall of Las Huertas Canyon in the Sandia Mountains about 35 miles northeast of Albuquerque. The cave is 2 to 3 meters in diameter and extends 135 meters into the mountain where it closes in. The cave is now dry and dusty for the first 100 meters; further in it is still dry, but the dust is damp enough to lie on the floor; at the end it is damp. The upper deposits consist of a layer of dust and guano containing Pueblo refuse, including potsherds dating from the period 1400 to 1600 A.D. Below this dusty layer is a stalagmite floor ½ to 6 inches thick overlying and sealing in, without possibility of contamination, the lower beds. These consist of (1) an Upper Breccia, containing Folsom artifacts; (2) a sterile layer of yellow ochre; (3) a Lower Breccia, containing the new Sandia culture; (4) a sterile gray clay. The breccias consist of fragments of limestone, chert, yellow ochre, fossil bone and artifacts cemented by calcium carbonate. The larger part of the material is camp refuse which has moved down the sloping floor. That there was once an outer chamber which has now disappeared seems obvious, as in the Upper Breccia there are no hearths and only a few in the Lower Breccia. There is so much refuse that a long occupation must be inferred and many hearths should occur unless their absence by reason of a disappearance of the entrance chamber be inferred.

The sterile gray clay at the base is an ordinary cave earth reflecting faintly moist conditions.

The Lower Breccia containing the Sandia culture shows increasing cementation from bottom to top. Thus an increasing drip of water from the roof must be inferred. Not only was calcium carbonate deposited, but also limonite (yellow ochre) which, however, was largely broken up and incorporated in the breccia as fragments. The layer of ochre is sterile, and it must be assumed that the entrance was closed or that the cave was so wet that not even animals could use it. Increased wetness seems a necessary postulate, as in no other way may the nearly complete absence of calcium carbonate be explained. There must have been so much water that the lime was carried to areas below the level of the cave. The Upper Breccia containing the Folsom culture is cemented by crystalline calcium carbonate demonstrating a strong drip from the roof which continued into the period of the stalagmite layer. At the time of the formation of the stalagmite layer the entrance must have been closed, as this layer is sterile. It may be that at this time the entrance chamber was sheared off by a rock fall. The drip from the roof gradually ceased, never to be renewed.

The pre-Pueblo deposits of this cave may thus be attributed to a single episode by which the cave became wetter to a climax at the time of the yellow ochre and the wetness ended with the stalagmite layer. In order that the cave should be wet, one must suppose a greater precipitation on the ridge in which the cave lies. Also there must have been a vegetative change from the present pinyon-juniper woodland to a forest of pine or spruce. The lower pine boundary is now about

[19] E. Antevs, Canada Geol. Survey, Mem. 18, 1931.
[20] Frank H. H. Roberts, Jr., personal communication.
[21] Frank C. Hibben, *Amer. Antiquity*, 2: 4, 260–263, 1937. And *Smithson. Misc. Coll.* (in press).

8,300 feet or 1,000 feet above the ridge. Such a lowering of the forest zones may be compared with the Wisconsin lowering of the snow-line estimated for the Southern Rockies at 2,000 feet by Klute.[22]

The Sandia cave deposits thus belong to a wet and presumably also a cold episode comparable in its intensity to the climatic fluctuations of the Wisconsin. To which of these fluctuations toward the wet and cold does it belong? If we accept the results of the Lindenmeier investigation, the Folsom culture flourished just after the climax of the Corral Creek or Wisconsin 3 glaciation. As Folsom points occur in the Upper Breccia and the Upper Breccia follows the climax of wetness in the cave, this climax should also be Wisconsin 3. The Lower Breccia and its contained Sandia culture would therefore be assigned to this period of glaciation also, but in a position earlier than the climax or more than 25,000 years ago.

As occupation of the cave by the people of the Sandia culture and the deposition of the Lower Breccia began together, it appears that the cave had been previously uninhabited. Thus there is no available geologic information on the date of arrival of the people who carried the Sandia culture into New Mexico or into the continent, except that the date must have been earlier than the cold-wet episode of W3. Also there is no information as to when the Sandia people ceased to occupy the area. So far as the evidence of the cave permits, at some time about the climax of Wisconsin 3, the Sandia culture was succeeded by the Folsom culture. Whether this change was induced by the incoming of new people or by cultural evolution remains in the realm of anthropological speculation. Furthermore, the cave deposits give no data as to time when the Folsom culture died out, and was succeeded by later cultures.

Times of Migration into the Continent

The proved existence of a pre-Folsom culture and the inference here set forth that this culture flourished before the climax of the last ice (Wisconsin 3) raises anew the question of the time of entrance of man into the continent. The antiquity of many finds has been challenged on the ground that entrance into the continent must have occurred after a partial withdrawal of the last ice. This theory has been elaborated by Antevs[23] from its earlier form set forth by Johnston.[24] As the Canadian great plains were covered by ice in part derived from the Cordillera on the west and in part from the Kewatin region to the east, passage down the plains was barred until the time when the ice withdrew, forming a corridor. This time is estimated by Antevs as about 10,000 years after the climax of the last ice (W3) or 15,000 years ago. It is contended that entrance by man must be later than 15,000 years ago or else it was "pre-Wisconsin." However, this theory ignores the three-fold character of the Wisconsin. The three substages were separated by interstadial periods as mild in climate as the present. The corridor should therefore have been open twice within the Wisconsin.

The existence of the pre-Mankato, W2/W3, interstadial is attested by the Two Creeks Forest bed[25] of the State of Wisconsin which underlies the Mankato till and overlies the till of the next older stage. This bed contains the remains of a forest like that of the present in Manitoba. With such a mild climate in Wisconsin one must assume that little or no ice remained in Labrador.

The idea that a long interval intervened between the Iowan, W1, and the next younger stage, the Tazewell-Cary, W2, has long been held. The evidence of a mild climate in this interval is not so definite. Near Lisbon, Iowa, where the "Peorian" loess is thick its basal portion is unleached and calcareous and rests on calcareous Iowan till. There is no weathering of the till.[26] On these facts and on evidence that the "Peorian loess" in Illinois contains larch twigs and moss, it is obvious that the loess is essentially glacial and was mostly deposited in the early stages of retreat. In the famous Farm Creek section near Peoria, Illinois, the unweathered "Peorian" loess underlies the Tazewell (Shelbyville) till.[27] Near the west end of the section, however, there is preserved a humus-bearing soil of very infantile development, elsewhere cut off by the overriding Tazewell ice.[28] West of Mackinaw, Illinois, the loess also has an infant soil development and is overlain by the Tazewell till.

These data indicate that some amelioration of climate occurred in the Iowan-Tazewell interval, but it is as yet necessary to rely on Europe for evidence that a complete retreat of the ice and a mild climate characterized the interstadial interval W1/W2.

If, then, we accept the threefold division of the Wisconsin and the existence of two interstadial periods of mild climate, there are two opportunities for the formation of the corridor on the Canadian Plains within the Wisconsin period. In order to explain the pres-

[22] F. Klute, *Zeitschr. f. Gletscherkde,* 16: 70–93, 1928.
[23] E. Antevs, *Geog. Rev.,* 25: 302–309, 1935.
[24] W. H. Johnston, "Quaternary Geology of North America in Relation to the Migration of Man: The American Aborigines." Ed. by D. Jenness, pp. 9–45, 1933.
[25] L. R. Wilson, *Wisc. Acad. Sci. Trans.,* 27: 31–46, 1932.
[26] W. C. Alden and M. M. Leighton, *Iowa Geol. Survey,* 26: 156–157, 1915.
[27] M. M. Leighton, *Jour. Geol.,* 34: 167–174, 1926.
[28] M. M. Leighton, "The Peorian Loess and the Classification of the Glacial Drift Sheets of the Mississippi Valley," *Jour. Geol.,* 39: 48–50.

ence of Sandia man before the climax of W3, it is only necessary to assume that he entered the continent in the interstadial W2/W3 or at the time of the Two Creeks forest bed.

The implication that man entered the interval in W2/W3 or previous to the Mankato ice has an immediate bearing on the much disputed Minnesota "Girl."[29] This skeleton found in the varved silts of Glacial Lake Pelican was accompanied by a bone knife and two shell ornaments, one of which is a Gulf Coast species. Thus the cultural objects imply trade relations with the Gulf of Mexico and therefore a considerable time of cultural development previous to the date of the skeleton. On this account there has been much anthropological objection to the date assigned the skeleton on geologic grounds. Lake Pelican existed when the ice was forming the Big Stone moraine or after the climax of the Mankato, W1, at a time estimated at 5,000 years after the climax or 20,000 years ago.[30] It is obvious that if man entered the continent in pre-Mankato time there was opportunity for a very considerable cultural development before the date of the Minnesota skeleton. The anthropological objections to this find are thus no real barriers. Only the questions raised by the absence of trained observers at the time of the discovery remain.

The Berclair Terrace of Bee County, Texas

One of the most important new finds lies in the Coastal Plain of Texas in terrace deposits on tributaries of Mission River in Bee County, Texas, as reported by Sellards.[31] Twenty-five species of fossil vertebrates have been collected at fourteen localities. One site in the Buckner ranch has been excavated. Here deposits of the Berclair terrace rest disconformably in fossiliferous Pliocene beds. The terrace consists of a basal part (sand and gravel) with fossil vertebrates and artifacts, a middle horizon (silt) which is sterile, and an upper part containing a different type of artifact. The artifacts of the basal part are a strange assemblance of Folsomoid, Yuma, and side-notched triangular points. The upper horizon contains more familiar types like those in the base of the Morkiss mound or the lower archeological horizons of Central Texas. These artifacts are scattered in the upper horizon, which was presumably flood-disturbed, and they are thus younger than the main body of the terrace.

Both the base and top of the Berclair terrace have a lower slope than the present stream grade, and about ten miles from the sea join with and merge with the Beaumont plain, which has an elevation of seventy or eighty feet above sea level. This plain is underlain by the Lower Beaumont clays. The vertebrate fauna also indicates that the Berclair terrace is the age equivalent of the Lower Beaumont or at least its upper portion. The vertebrate fauna is also similar to the bone-bearing layer or No. 2 horizon of the famous Vero and Melbourne localities of Florida. The human culture of the lower horizon is thus definitely tied to the stratigraphic sequence of the Gulf Coastal Plain. Unfortunately it is as yet impossible to relate the Pleistocene beds of this region to the climatic rhythm of the Pleistocene with any assurance. In the Texas portion of the Coastal Plain there have been diastrophic movements, so that the Beaumont is known to be deformed. In Florida, however, there has been little diastrophic movement, and it seems likely that the Melbourne formation is related to a sea level higher than the present. Thus it might be related to either the higher sea level of the interstadial W2/W3 or more probably to that of the period of greatest melting or post-Glacial optimum about 5,000 years ago.

It is distressing that no more definite correlation can be attempted at present. If however, the latest form found is considered as setting the date of a deposit, the side-notched forms of the basal bed would fit best into a late post-Glacial horizon. More complete geologic and archeological knowledge is obviously necessary.

The Alluvial Chronology

In the Southwest the floodplains of the minor streams are underlain by alluvium of several ages. Repeatedly these streams have incised their channels and thereafter built up their floodplains as summarized in Table II. These alternations of régime appear to be climatic and presumably synchronous over the region. Synchroneity has, however, been established only for the period of alluviation which falls in the interval 1400 to 1885 A.D. or later. The next previous period of erosion is more or less well dated in the interval 1100 or better 1250 to 1400 A.D. The problems both geologic and anthropological involved in this chronology have been recently described.[32] It is pertinent here to consider some of the difficulties of correlation.

There appear to be three episodes of alluviation and three episodes of erosion. The dates of the second and third period of erosion and of the third period of alluviation are well established in some localities. Further data are needed, but the methods are known and these data will be easily acquired with the progress of archeological work in the area.

[29] A. E. Jenks, "Pleistocene Man in Minnesota, a Fossil *Homosapiens*," 197 pp. Qto. Univ. Minn. Press, 1936.
[30] Antevs and Leverett in Jenks, *op. cit.*
[31] E. H. Sellards, *Geol. Soc. Amer. Bull.*, 51: 1627–1658, 1940.
[32] Kirk Bryan, "Pre-Columbian Agriculture as Conditioned by Periods of Alluviation in the Southwest," 8th Amer. Sci. Congr. Proc. (in press).

TABLE II

ALTERNATE EROSION AND ALLUVIATION IN SOUTHWESTERN VALLEYS

	Erosion	Various dates after 1885 A.D. Established on historical evidence.
3.	Alluviation	Contains artifacts and potsherds indicating deposition from about 1400 to 1885 A.D.
	Erosion	In places dated by archeological means in the interval 1100–1400 A.D., probably 1250 A.D. and later.
2.	Alluviation	In places contains human cultures, may eventually be divisible into two or more periods of alluviation.
	Erosion	Large gullies formed with evidence of strong wind action.
1.	Alluviation	Usually contains extinct animals; artifacts generally absent, except the Abilene-Gibson culture of the Durst silt.

The second period of alluviation presents many problems. In places in New Mexico and Arizona it appears to be of early Puebloan date. In Texas it corresponds in time to part of the Clear Fork culture. These and related archeological stages are not yet harmonized, and it is possible that this second period of alluviation is actually a complex that will prove to be divisible into two or more stages.

The first period of alluviation is even more synthetic. The older beds which usually are slightly cemented and contain extinct animals have been put in this category. The fossils are so meager in number that they afford no critical evidence as to age. Only near Abilene is this older body of alluvium artifact-bearing. Here the Durst silt contains *Elephas,* Abilene and Gibson points.[35] These cultural objects are generally thought to have considerable antiquity, but until a definite tie with the Folsom culture can be made, the alluvial sequence hangs in the air. Even if a tie were made in Texas, the other alluvial beds which have been correlated with the Durst, but have so far proved sterile, may not be the exact equivalent.

The alluvial chronology even in its imperfect present state is an advance in knowledge. It seems likely that it may eventually be integrated with the sequence of dune deposits. Hack[34] has correlated the main body of dunes in the Hopi Country with the first period of erosion. Huffington and Albritton[35] have suggested that the three periods of dune formation in the southern High Plains correspond to the three periods of erosion of this sequence. When and if the alluvial and dune sequences can be tied to the general climatic rhythm, a powerful tool in chronology will have been forged.

CONCLUSION

The problem of the antiquity of man in America has lost its heretofore hypothetical character. It has become a series of detailed problems involving the antiquity of several Paleo-Indian cultures. These cultures, when better known, can be tied to each other archeologically. Also each site studied by geologic methods contributes to a general geologic chronology in step with the rhythm of climatic fluctuations.

OBITUARY

WILLIAM WEBBER FORD
1871–1941

WILLIAM WEBBER FORD, professor emeritus of bacteriology in the Johns Hopkins University, died of cancer at the Johns Hopkins Hospital on February 10, 1941, following a short illness. He was born December 15, 1871, in Norwalk, Ohio, the son of Dr. James Ford and Cornelia Cook Ford. Upon completion of his preparatory education he entered Western Reserve University, from which he received the A.B. degree in 1893. Possessed of an inquiring mind and influenced by his close association with his father it was quite natural that he should then take the obvious next step and enter upon the study of medicine. This he did by matriculation in the Johns Hopkins Medical School, from which he received the M.D. degree in 1898. The next year, 1898–1899, he served as resident house officer in the Johns Hopkins Hospital.

During his medical course Ford came directly under the influence of Dr. William H. Welch, who at that time was teaching pathology and bacteriology in the Medical School. As a consequence of this contact, though also influenced by his association with Kelly, Halstead and Osler—the Big Four of the early days of Hopkins—Ford's natural interest in scientific medicine and research received an impetus which resulted in his election of a career in teaching and investigation rather than in the clinical field. During the years 1899–1901 Ford served as a fellow in pathology at McGill University, and from that institution he received the D.P.H. in 1900. Subsequently, he was appointed a fellow in the Rockefeller Institute for Medical Research, 1901–1903, studying at the Institute for Infectious Diseases in Berlin, 1901–1902, and at the Johns Hopkins University, 1902–1903. In the years immediately following he successively served as instructor in bacteriology, 1903–5; associate, 1905–6; and associate professor, 1906–10, in Welch's depart-

[33] Cyrus N. Ray, *Tex. Arch. Pal. Soc. Bull.*, 12: 223–237, 1940, and papers referred to.

[34] John T. Hack, *Mus. of North. Ariz. Museum Notes,* Vol. II, pp. 67–73, 1939. *Geogr. Rev.*, Vol. 31, pp. 240–263, 1941.

[35] Roy Huffington and C. C. Albritton, *Am. Jour. Sci.* (in press).

ment in the Johns Hopkins School of Medicine. In 1910 he was appointed associate professor of bacteriology and hygiene in the Johns Hopkins School of Medicine, a position he held until 1917. During 1917–18 Dr. Ford was lecturer in hygiene and legal medicine and from 1918–1936 lecturer in hygiene in the School of Medicine. In the meantime the School of Hygiene and Public Health in the Johns Hopkins University had been organized with Welch as its first director and professor of bacteriology and immunology. In this new venture it was quite natural that Dr. Welch should take his assistant with him from the Medical School, and so it was that Ford became associate professor of bacteriology in the School of Hygiene and Public Health in 1918. In this position he virtually organized the department of bacteriology and continued to serve as its real head until 1922, when Dr. Welch relinquished the professorship to devote himself exclusively to the administrative duties of the rapidly growing school; Dr. Ford thereupon became professor of bacteriology and continued to hold this title until his retirement in June, 1937. From 1937 to the date of his death he held the title of professor emeritus of bacteriology in the Johns Hopkins University.

W. W. Ford was one of the most modest and retiring of men and I am sure was generally unappreciated except by those having the opportunity of close association with him. These fortunate individuals could not fail to recognize his sterling qualities; his thoroughness, the breadth and depth of his knowledge, his keen scientific insight, his modesty, generosity, loyalty and innate kindliness. In his contact with colleagues and students no one ever more readily placed himself at the disposal of others. His fine record of published work covered a remarkably wide range of subjects and was equaled only by what he did, quietly yet meticulously, on behalf of his associates and students. It would be too much to reproduce Dr. Ford's complete bibliography; suffice it to say that it includes original observations in the fields of pharmacology, immunology, bacteriology, the higher fungi and of recent years, in the history of his chosen branch of science. During his early career Dr. Ford was particularly interested in mushrooms and mushroom poisoning and was internationally recognized as an authority on the subject. His scientific publications in this field were numerous and, though somewhat diverted later on, he never really lost his interest in this group of plants. Beyond this, and without disparaging any of his other work, it may be said that Dr. Ford's chief interest lay in the field of descriptive and determinative bacteriology. Here he was at his best, and his years of devoted study culminated in the publication of his "Text-book of Bacteriology," which is truly a classic from the standpoint of the authentic description of species. Most recently—since his retirement—his studious efforts came to fruition in his published "History of Bacteriology."

Dr. Ford was a member of many scientific societies but was particularly interested in the Society of American Bacteriologists, the American Association for the Advancement of Science, the American Medical Association, the American Society of Naturalists, the American Association of Pathologists and Bacteriologists and the Society for Experimental Medicine and Biology.

In his adopted State of Maryland he was repeatedly appointed a member of the State Board of Health, serving during the years 1913–1935.

In 1902 Dr. Ford married Louisa Wright Neilson, a water-color artist of note, and their daughter, Mrs. Sidney Montgomery, is now living in West Chester, Pennsylvania. Mrs. Ford died in 1930, and Dr. Ford subsequently married Charlotte Manning, who survives him, together with a daughter, Miss Margaret Annina Ford.

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SCIENTIFIC EVENTS

SYMPOSIUM ON THE RESPIRATORY ENZYMES AND THE BIOLOGICAL ACTION OF THE VITAMINS

A SYMPOSIUM on "The Respiratory Enzymes and the Biological Action of the Vitamins" has been arranged jointly by the University of Wisconsin and the University of Chicago to be held from September 11 to 17, inclusive. The first sessions, from September 11 to September 13, will be devoted largely to the respiratory enzymes and will be held on the University of Wisconsin campus. On September 14, after an outing, the group will move to the University of Chicago where from September 15 to September 17 the sessions will be devoted to the vitamins.

At Madison the speakers will be Otto Meyerhoff, Eric Ball, F. Lipmann, K. G. Stern, F. Schlenk, T. R. Hogness, Elmer Stotz, C. F. Cori, E. A. Evans, Jr., and P. P. Cohen. The following will speak at Chicago: W. H. Taliaferro, R. R. Williams, S. Ochoa, Norman Jolliffe, P. György, W. H. Sebrell, C. A. Elvehjem, D. T. Smith, S. Lepkovsky, T. Spies, R. J. Williams, E. Gordan, V. du Vigneaud, W. H. Griffith, C. G. King, F. C. McLean, D. W. MacCorquodale, H. P. Smith and E. D. Warner.

The speakers and discussion leaders will take part in both the Wisconsin and Chicago sessions and on each campus will be housed in one of the newer dormitories. Meals and lodging in these dormitories may be obtained for both men and women at approximately three dollars and fifty cents per diem. Reservations can be made either with T. R. Hogness, department of chemistry, the University of Chicago, or with Van R. Potter, McArdle Memorial Laboratory, the University of Wisconsin.

The symposium is supported by funds from both the Wisconsin Alumni Research Foundation and the Abbott Laboratories. The sessions at Chicago form a part of the University of Chicago's semi-centennial celebration.

THE AMERICAN MUSEUM OF NATURAL HISTORY

IN the annual report for 1940 of Dr. Roy Chapman Andrews, director of the American Museum of Natural History, it is reported that the attendance of visitors during the year numbered 1,582,379. Attendance on lectures, special exhibitions and motion pictures number 326,775, and on Bear Mountain nature trails, 465,000. The number of pupils in New York City schools who attended free classes in the Hayden Planetarium, rose to 67,159. Instruction and lectures were also given in classes outside the museum to 149,441 children. The number of paid admissions to the Hayden Planetarium was 287,187.

Dr. Andrews points out that these are most encouraging increases, and that they definitely prove the strong position and extending influence of the museum as an important source of objective education for the community and the nation. But aside from these impressive figures, is the fact that the museum, through its Department of Education, reached 26,187,674 students through distribution of educational motion pictures, lantern slides and circulating natural history collections. This is an increase of more than 1,110,000 over 1939.

In discussing the activities of the museum for the year, Dr. Andrews said:

> Although expeditionary work in most parts of the world was restricted or completely abandoned because of wars, some collecting was accomplished and field work in the Western Hemisphere proved particularly fruitful. Fortunately, all specimens for the Akeley African Hall are secured, so that this record of the magnificent wild game with some of the avifauna of the continent of Africa is nearly finished. The North American Mammal Hall is intended to preserve for all time, as the Akeley Hall does for African wildlife, the animals of North America which are also rapidly disappearing.
>
> The energetic efforts of the Committee for the North American Hall have secured pledges for all the main groups, and the specimens and accessories for many of these are already collected. In the Whitney Memorial Bird Hall, the group showing the birds of the region of the Snow Mountains in New Guinea, presented by Richard Archbold and constructed and installed with Whitney funds, was completed and opened to the public in the summer.
>
> The museum owes a debt of gratitude to the mayor, the commissioner of parks and to other officials of the city administration, without whose support the institution could not have continued its record of progress. The Work Projects Administration furnished us, for another year, many workers of varied types of training who contributed a large and valuable share in our accomplishments.

With respect to membership, Wayne M. Faunce, vice-director and executive secretary, reported that membership enrolment reached an all-time high in 1940, with 25,455 members. He also reported that *The Natural History Magazine*, devoted to the publication of research and exploration in the natural history field, had reached a circulation of 28,073.

The result of all operations during the year showed that while actual disbursements exceeded the estimate by $1,059, the receipts were $96,794 in excess of budgeted income. This increase was due mainly to the efforts of the Ten-Year Development Program, whereby $70,729 was received from friends of the museum to be applied toward the deficit. In addition, income from capital funds applied to the deficit was $47,375 more than the amount included in the budget adopted at the beginning of the year. After taking into consideration other sources of income which varied with the amounts budgeted, the deficit for the year amounted to $11,999. On January 13 the trustees authorized a transfer from capital funds of an amount sufficient to liquidate this deficit. Of the total receipts for the year, amounting to $1,913,262, the sum of $496,772 was appropriated by the City of New York.

THE HARVARD FOREST

THE resources of the Harvard Forest at Petersham, Mass., have been increased by the construction of two modern fireproof buildings: the Fisher Museum, named in honor of Professor Richard T. Fisher, first director of the forest, and the adjoining administration building, Shaler Hall, named in honor of Dean Nathaniel S. Shaler, whose interest in forestry was responsible for the initiation of instruction in this field at Harvard University in 1904. A third unit, a large garage for cars, trucks and tractors, was completed last year. This attractive set of buildings was made possible through the generosity of a friend of the forest who desires to remain anonymous.

The Fisher Museum was especially designed to house

the famous forest model collection, twenty-three in number, which illustrate the history, management and use of the local forests. The forest models have been under construction for the past ten years in the studios of Theodore B. Pitman, Cambridge. The museum also contains a large number of case exhibits arranged in the gallery above the models.

Shaler Hall contains a large forestry library, laboratories, offices and living quarters for resident students and visiting scientists.

The new buildings were dedicated on May 13 in the presence of members of the Harvard University Corporation, the Board of Overseers and the members of the committee appointed to visit the Harvard Forest. President James B. Conant presided at the dedication and gave the principal address. Other speakers were Dr. E. D. Merrill, administrator of the Botanical Collections of Harvard University, and A. C. Cline, director of the Harvard Forest. On May 14 the buildings were opened to the public in the presence of nearly 500 invited guests.

The Fisher Museum will be open to the public at the usual hours, and field trips to parts of the surrounding 2,200-acre research and demonstration forest will be arranged.

SUMMER MEETINGS OF THE AMERICAN MATHEMATICAL SOCIETY

THE forty-seventh summer meeting of the American Mathematical Society will be held at the University of Chicago from September 2 to 6, in conjunction with meetings of the Mathematical Association of America and the Institute of Mathematical Statistics. At the time of the meetings the University of Chicago will be celebrating the fiftieth anniversary of its founding, with special exercises, the theme of which has been designated by the university as "New Frontiers in Education and Research." A preliminary announcement of the meeting of the society has been issued.

In connection with the meeting of the American Association for the Advancement of Science to be held at the University of New Hampshire, from June 23 to 27, sessions with the Section on Mathematics of the association (Section A) will be held on June 26 and 27.

A report of the work of the joint War Preparedness Committee of the American Mathematical Society and the Mathematical Association of America is printed in *The Mathematics Teacher* for May, in an article entitled "Mathematics in the Defense Program" written by Professor Marston Morse, of the Institute for Advanced Study, chairman of the committee, and by Professor William L. Hart, of the University of Minnesota, chairman of the Sub-Committee on Education for Service.

As a result of the recent report on mathematics in industry, prepared under the auspices of the Committee on Survey of Research in Industry (appointed by the National Research Council and reporting to the National Resources Planning Board), and in line with the recommendations of the joint Committee on War Preparedness, two centers for training in advanced work in certain special fields of applied mathematics are to be inaugurated this summer—one at Brown University and the other at New York University.

PRESENTATION OF THE WILLARD GIBBS MEDAL

THE Willard Gibbs Medal of the Chicago Section of the American Chemical Society was presented to Dr. Edward A. Doisy, of the School of Medicine of St. Louis University, in Chicago on May 23.

Dr. William Lloyd Evans, of the Ohio State University, president of the American Chemical Society, presented the medal to Dr. Doisy; Dr. E. H. Volwiler, in charge of research and development of the Abbott Laboratories, described his scientific achievements. Dr. Howard B. Lewis, director of the College of Pharmacy of the University of Michigan, spoke on his personal qualities. Dr. W. F. Henderson, of the Visking Corporation, chairman of the Chicago Section, discussed the Willard Gibbs Medal, which, recognizing "conspicuous contributions in chemistry," was founded in 1911 by William A. Converse, secretary of the Chicago Section from 1901 to 1909, and was named for Josiah Willard Gibbs, professor of mathematical physics at Yale University from 1871 to 1903, called "America's greatest man of science." Dr. Doisy delivered the Willard Gibbs Medal address on "Recent Developments in the Investigation of Vitamin K and Other Antihemorrhagic Compounds" on May 24.

In the official announcement the following account is given of the work in recognition of which the medal was awarded.

Dr. Doisy began his researches on female sex hormones eighteen years ago and is still pursuing them with undiminished vigor. In 1929 he isolated the first pure crystalline female sex hormone, theelin. A second hormone, theelol, was shortly isolated in crystalline form in Dr. Doisy's laboratory and elsewhere.

In 1936 Dr. Doisy isolated dihydrotheelin, a third female sex hormone. He also developed a satisfactory method for the preparation of the chorionic gonadotropin or so-called anterior pituitary-like substance. The commercial production of theelin and other estrogenic substances has become of great importance to the medical profession.

Dr. Doisy's interest in the antihemorrhagic vitamins was entirely independent of his endocrinological research. Work on the fractionation of vitamin K extracts was begun in 1936 and by the early part of 1939 two antihemorrhagic vitamins had been isolated, vitamin K_1 from alfalfa, and vitamin K_2 from putrefied sardine meal.

The chemical constitution of vitamin K_1 was worked

out and its synthesis accomplished. Experiments have already indicated the probable structure of vitamin K_2. A considerable number of synthetic compounds known as naphthoquinones have also been shown to possess antihemorrhagic activity.

The utilization of vitamin K preparations and of the synthetic naphthoquinones by the medical profession has already resulted in the saving of many lives not only among those suffering from hemorrhagic disease due to obstructive jaundice but also among the newborn where the usual condition of hypoprothrombinemia may be easily prevented by prenatal administration of the antihemorrhagic compounds. In this way it is possible to decrease the incidence of intracranial hemorrhage and other frequently fatal hemorrhagic conditions in the newborn.

Dr. Doisy has made important contributions to many other biochemical problems, including the origin of endogenous uric acid; determination of the inorganic components of the blood—sodium, potassium, chloride and phosphorus; blood buffers and carbon dioxide transport; preparation of insulin of high potency and its effect on blood composition, and formation of lactic acid in the muscles of depancreatectomized animals.

Vladimir N. Ipatieff, director of chemical research of the Universal Oil Products Company, Chicago, received the Willard Gibbs award in 1940. Previous medalists include: Svante Arrhenius, of Sweden; Mme. Marie Curie, of France; Sir James Irvine, of Scotland; Richard Willstaetter, of Munich, and from the United States Theodore W. Richards, Leo H. Baekeland, Ira Remsen, Arthur A. Noyes, Willis R. Whitney, Edward W. Morley, William H. Burton, William A. Noyes, F. G. Cottrell, Julius Stieglitz, Gilbert N. Lewis, Moses Gomberg, John Jacob Abel, William D. Harkins, Claude S. Hudson, Irving Langmuir, Phoebus A. Levene, Edward C. Franklin, Harold C. Urey, Charles A. Kraus, Roger Adams, Herbert N. McCoy, Donald Dexter Van Slyke and Robert R. Williams.

HONORARY DEGREES TO BE CONFERRED AT THE FIFTIETH ANNIVERSARY OF THE UNIVERSITY OF CHICAGO

THIRTY-TWO honorary degrees in the sciences and the humanities will be awarded at a special convocation of the University of Chicago on September 29, at the close of the four-day academic festival of the fiftieth anniversary celebration. The degrees to be conferred in the sciences follow:

Charles E. Allen, professor of botany, the University of Wisconsin, discoverer of sex chromosomes in plants.

Charles H. Best, professor and chairman of the physiology department at the University of Toronto, co-discoverer of insulin.

George D. Birkhoff, professor of mathematics at Harvard University, leading contributor to the fundamentals of dynamics.

Reginald A. Daly, professor of geology at Harvard University, authority on the origin of rocks and glaciers.

Edward A. Doisy, professor of biological chemistry at St. Louis University, noted for his identification of pure female hormone and two types of vitamin K.

Ernest W. Goodpasture, professor of pathology at Vanderbilt University, inventor of new methods of studying disease viruses.

Evarts A. Graham, professor of surgery at Washington University, St. Louis, nationally recognized for his contributions to the technique of modern surgery.

Libbie Hyman, member of the American Museum of Natural History in New York, noted for her contributions to the life processes of animals and internationally recognized as an authority on invertebrate zoology.

Herbert S. Jennings, professor emeritus of zoology at the Johns Hopkins University, authority on the behavior of simple forms of animal and plant life.

Karl S. Lashley, professor of neuropsychology at Harvard University, famous for his investigations of brain mechanisms.

Ernest O. Lawrence, professor of physics at the University of California, Nobel Laureate, inventor of the cyclotron, making possible sub-atomic chemistry.

Robert H. Lowie, professor of anthropology at the University of California, authority on the American Indian.

Robert A. Millikan, chairman of the executive council of the California Institute of Technology, Nobel Laureate, measurer of the electron and authority on cosmic rays.

Carlos A. Monge, dean and professor of medicine at the University of San Marcos, Lima, Peru, discoverer of "Monge's Disease," characteristic of the inhabitants of high altitudes.

Linus C. Pauling, professor and chairman of the department of chemistry at the California Institute of Technology, authority on forces between atoms in molecules and crystals.

Thomas M. Rivers, director of the Hospital of the Rockefeller Institute, international authority on the viruses of human and animal diseases.

Henry N. Russell, director of the Princeton Astronomical Observatory, discoverer of giant and dwarf stars and pioneer in the study of the evolution of the universe.

Florence B. Seibert, associate professor of physiological chemistry at the Henry Phipps Institute, Philadelphia, authority on the chemistry of tuberculin.

Donald D. Van Slyke, member of the Rockefeller Institute, inventor of new methods of chemical analysis used in the treatment of disease.

Oswald Veblen, professor of mathematics at Princeton University, internationally known for his contributions to geometry.

Robert R. Williams, director of chemistry at the Bell Telephone Laboratories in New York, discoverer of vitamin B_1.

SCIENTIFIC NOTES AND NEWS

THE Kober Medal of the Association of American Physicians was presented to Dr. William de B. MacNider, Kenan research professor of pharmacology at the University of North Carolina, at the meeting of the association in Atlantic City, which was held on May 6 and 7.

DR. ANSON MARSTON, dean emeritus of the Engineering Division of the Iowa State College, has been awarded the Lamme Gold Medal of the Society for the Promotion of Engineering Education. The presentation will be made at the annual dinner of the society on June 26 during the Ann Arbor meeting.

THE Mendel Medal of Villanova College, "given annually for outstanding achievement in science," has been presented to Dr. Eugene M. K. Geiling, professor of pharmacology at the University of Chicago, "for his contributions to the knowledge of the pituitary gland, its relation to other glands and for his assistance in the crystallization of insulin."

THE American Library Association, through its special committee, has awarded the Oberly Memorial Prize for 1940–41 to Dr. E. D. Merrill, of the Arnold Arboretum, and E. H. Walker, of the Smithsonian Institution, for their "Bibliography of Eastern Asiatic Botany," as the outstanding bibliography for the period. Awards are made once in two years, the field being limited to agriculture and the natural sciences. The Eunice Rockwood Oberly Memorial Fund of the American Library Association was established in 1924.

THE eighteenth annual Colloid Symposium has been designated "The Wilder D. Bancroft Colloid Symposium," in honor of Dr. Bancroft, emeritus professor of chemistry at Cornell University, distinguished for his work on colloid chemical phenomena. The meeting will be held at the university on June 19, 20 and 21. A lecture by Dr. Bancroft will be given entitled "Thirty Years of Colloid Chemistry." The symposium will be divided into four sections: Surface Chemistry, Inorganic Colloids, Organocolloids and Protein Chemistry.

THE Albert H. Ketchum Memorial Award for 1941 of the American Association of Orthodontists was presented on May 8 at the closing session of the fortieth annual meeting held in New York City, to Dr. Frederick B. Noyes, dean emeritus of the College of Dentistry of the University of Illinois.

FORMER students of Dr. Ernst Julius Berg, dean of engineering at Union College, Schenectady, N. Y., gave on May 17 a dinner in his honor to celebrate his long service to the college with which he became associated in 1913 as professor of electrical engineering. A portrait of Dr. Berg, painted by John C. Johansen, was presented by Ralph Henry Tapscott, president of the Consolidated Edison Company of New York. President Dixon Ryan Fox accepted the portrait for the college.

THE degree of doctor of science will be conferred at the ninety-first commencement exercises on June 16 of the University of Rochester on Dr. Warfield T. Longcope, professor of medicine at the Johns Hopkins University; on Dr. George Washington Carver, of the Tuskegee Institute, and on Dr. René Jules Dubos, associate of the Rockefeller Institute for Medical Research.

OFFICERS of the American Institute of Nutrition were elected as follows at the recent meeting in Chicago: *President,* Dr. Albert G. Hogan, professor of animal husbandry and chairman of the department of agricultural chemistry at the University of Missouri; *Vice-president,* Dr. Leonard A. Maynard, professor of animal nutrition and director of the U. S. Plant, Soil and Nutrition Laboratory at Cornell University; *Secretary,* Dr. Arthur H. Smith, head of the department of physiological chemistry at the College of Medicine of Wayne University, Detroit; *Treasurer,* Dr. W. H. Sebrell, of the National Institute of Health of the U. S. Public Health Service, Bethesda, Md.; *Councillors,* Dr. Thomas H. Jukes, instructor in poultry husbandry at the University of California, Davis; Dr. Lydia J. Roberts, professor and chairman of the department of home economics at the University of Chicago, and Dr. Howard B. Lewis, professor of biological chemistry at the Medical School of the University of Michigan.

DR. GEORGE M. GUEST, associate professor of pediatrics at the University of Cincinnati and fellow of the Children's Hospital Research Foundation, has been elected president of the Society for Pediatric Research.

DR. LEO JOSEPH LASSALLE, dean of the College of Engineering of the Louisiana State University, has been elected president of the Southeastern Section of the Society for the Promotion of Engineering Education.

AT a meeting in Richmond, Va., on May 5, of the American branch of the International League against Epilepsy the following officers were elected for the ensuing year: *President,* Dr. H. Houston Merritt, Boston; *Vice-presidents,* Dr. David C. Wilson, of the University of Virginia, and Dr. Milton Rosenbaum, Cincinnati; *Secretary-Treasurer,* Dr. F. A. Gibbs, Boston. Dr. Adolf Meyer, of Baltimore, was elected vice-president for America for the International League.

DR. PHILIP G. JOHNSON, of the department of edu-

cation of Cornell University, has been elected secretary-treasurer of the New York State Science Teachers' Association and chairman of its research committee.

DR. EDGAR O. LOVETT, first president of the Rice Institute, Houston, Texas, previously professor of astronomy at Princeton University, on attaining the age of seventy years, has resigned from the office to which he was called in the autumn of 1907. When the trustees of the institute shall have selected his successor, Dr. Lovett will become president emeritus. He will retain his membership on the self-perpetuating board of seven trustees to which he was elected in 1910. The Rice Institute was opened for the reception of students in the autumn of 1912.

PROFESSOR FREDERICK W. HEHRE, of the School of Engineering of Columbia University, has been appointed head of the department of electrical engineering.

DR. WEBSTER N. JONES, director of engineering of the Carnegie Institute of Technology, has been appointed a member of the Pennsylvania State Council on Defense.

HENRY N. OGDEN, professor of engineering, emeritus, at Cornell University, has been reappointed by Governor Lehman to a six-year term on the New York State Public Health Council.

DR. LEON BRILLOUIN, of the Collège de France, who is in residence this spring and summer at the University of Wisconsin as visiting professor of physics, is now giving until June 7 a course of lectures on elastic and electromagnetic wave propagation in crystals. From June 30 to August 8, he will offer in addition to quantum mechanics a course on short radio waves. Professor Brillouin was recently director of the French Broadcasting System.

DR. ARUNDELL J. K. ESDAILE, formerly secretary of the British Museum Library and lecturer in bibliography at the London University School of Librarianship, expects to visit the United States in the autumn. Since the outbreak of the war he has been in charge of microfilming documents at the British Museum, a project of the American Council of Learned Societies and the Library of Congress.

DR. EDWARD ELLERY, national president of Sigma Xi, returned recently from a ten-day visit to the University of Hawaii, during which he gave addresses on scientific subjects to a number of groups. Among these were an address on "Scientific Discovery and the Scientific Method," given to science students of the university, and a public address on "Science and Social Unrest." On April 4 he addressed the regular spring meeting of the Sigma Xi Club of Hawaii on "Facts and Fancy in Science." Dr. Ellery's visit was co-sponsored by the University of Hawaii and the Sigma Xi Club of Hawaii.

DR. FRANK A. GELDARD, professor of psychology in the University of Virginia, delivered the annual Sigma Xi lecture at the Carnegie Institute of Technology on May 10. The subject of his address was "Explanation in Science."

DR. ROBERT B. LINDSAY, chairman of the department of physics of Brown University, delivered the annual address to the Sigma Xi Club of the University of Maine on April 2. The subject of his lecture was "The Impact of Science on Civilization."

DR. D. E. MINNICH, chairman of the department of zoology of the University of Minnesota, addressed on May 2 a joint meeting of the South Dakota Academy of Science and the Academy of Social Sciences. The address was entitled "Human Reproduction in Relation to Social Progress." It was given at Augustana College, Sioux Falls, S. D.

DR. FRANKLIN C. MCLEAN, professor of pathologic physiology at the School of Medicine of the University of Chicago, delivered on May 2 the tenth Walter M. Brickner Lecture at the Hospital for Joint Diseases. He spoke on "Calcification and Ossification: Some Aspects of the Physiology of Bone."

DR. PHILIP D. MCMASTER, of the Rockefeller Institute for Medical Research, will be the main speaker at the nineteenth annual meeting of the American Association for the Study of Allergy in Cleveland, on June 3. His subject will be "The Lymphatic Participation in Human Cutaneous Phenomena."

AT the first meeting of the directors of the National Science Fund held on May 21 at the University Club, New York, Dr. William J. Robbins, director of the New York Botanical Garden, was elected chairman of the Board of Directors, and Winthrop W. Aldrich, chairman of the Board of the Chase National Bank of New York City, was elected vice-chairman. An account of the purposes of the fund is given in the issue of SCIENCE for May 9 (p. 446). Directors present at the organization meeting were: Albert F. Blakeslee, director, department of genetics, Carnegie Institution of Washington, Cold Spring Harbor; Luther P. Eisenhart, dean of the Graduate School, Princeton University; Herbert S. Gasser, director of the Rockefeller Institute for Medical Research; Walter S. Gifford, president, American Telephone and Telegraph Company; Ross G. Harrison, chairman, National Research Council; Carlton J. H. Hayes, professor of history, Columbia University; The Honorable Herbert Hoover, former President of the United States; Frank

B. Jewett, president of the National Academy of Sciences; Alfred N. Richards, professor of pharmacology, University of Pennsylvania; William J. Robbins, director of the New York Botanical Garden; Harlow Shapley, director of the Harvard College Observatory, and Tom K. Smith, president, the Boatmen's National Bank, St. Louis. Members of the executive committee are Winthrop W. Aldrich, Albert F. Blakeslee, Frank B. Jewett, William J. Robbins and Harlow Shapley.

THE Carnegie Corporation has renewed the grant to finance the Committee of Private Research of Western Reserve University for another year. Established a year ago as the outgrowth of the work of the late Dr. Robert C. Binkley, the committee encourages research and private scholarship. Dr. Harold A. Blaine will continue as director of the committee, and William S. Dicks as research associate.

AN Associated Press dispatch reports that the building of the Royal College of Surgeons in London was among the places damaged in recent air raids. It reads: "Valuable museum specimens were lost when the structure, twice slightly damaged in earlier raids, was hit by high explosive and fire bombs. The bulk of the famous Hunterian collection made by Dr. John Hunter, known as the founder of modern surgery, was buried under a pile of fire-swept débris. This collection was bought by the Government for £15,000 two years after Dr. Hunter's death in 1793."

Nature writes: "Owing to the generosity of the Rockefeller Foundation, which has provided a grant for the purpose, the Royal Society is in a position to give some assistance to scientific societies and associations which, as a result of war conditions, are experiencing financial difficulties in the publication of scientific journals."

THE Pharmaceutical Society of Great Britain celebrated in London on May 15 the centenary of its foundation. A thanksgiving service was held in the morning in the parish church of St. Pancras, and a commemoration meeting at Conway Hall was followed by a play, "Jacob Bell and Some Others," which recalled scenes surrounding the actual foundation of the society. The society received congratulations on its century of useful work from many medical associations, learned bodies, manufacturing and trading organizations in Great Britain and from pharmaceutical societies in all parts of the Empire and in the United States.

THE general meetings of the Linnean Society of London, according to *Nature,* were resumed, beginning on March 6. The centenary of the Royal Botanic Gardens, Kew, as a Government institution, occurred on April 1, and at the meeting on April 3, Sir Arthur W. Hill, director of the Royal Gardens, gave some account of the work of Kew during the past hundred years. At the meeting on May 1, the society observed the tercentenary of the birth of Nehemiah Grew, when Dr. Agnes Arber gave an account of his work and that of Marcellus Malpighi. The anniversary meeting was held on May 24, when the president addressed the society. The council is considering the possibility of prolonging the session into July.

DISCUSSION

IS EVOLUTION INSCRUTABLE?

THE undeniable importance of Professor Goldschmidt's recent volume on evolution,[1] and the weight which its author's name justly carries, make it doubly needful that certain of its implications be fully recognized. Dobzhansky's assertion[2] that the acceptance of Goldschmidt's central theory demands a "belief in miracles" seems to me to be literally true, though the statement deserves some amplification.

The difficulties which beset the Darwinian theory of evolution through the natural selection of small variations were recognized by many of Darwin's contemporaries, and were discussed at great length by Darwin himself. Alternative theories of "saltation" or progress through large, discontinuous "jumps" were proposed by contemporary critics, notably by St. George Mivart.[3] Indeed, the rudiments of this idea long antedated Darwin, as witness Geoffroy St. Hilaire.

Mivart's evolutionism, as is well known, was strongly tinged with theology. The continuous intervention of the Creator in the evolutionary drama was fundamental in his world outlook. There was nothing disturbing to him in the notion that complex, adaptive structures could arise abruptly, since all this happened under divine guidance. The "innate tendency" to vary he conceived to be "an harmonious one, calculated to simultaneously adjust the various parts of the organism to their new relations."

It is needless to say that Professor Goldschmidt entertains no such theological interpretation of natural phenomena. Nor can we suspect him of sympathy with "vitalism," "teleology," "innate tendencies" or other forms of biological mysticism. Indeed, Goldschmidt's position would perhaps be more understand-

[1] "The Material Basis of Evolution." Yale University Press, 1940.

[2] SCIENCE, October 18, 1940.

[3] "The Genesis of Species." Macmillan and Company, 1871.

able if he did cherish such views. For he contends that "macroevolution" (*i.e., real* evolution) comes to pass through single, abrupt genetic changes ("macromutations"), capable of bringing about phenotypic alterations of specific, generic or even much greater magnitude. The role of selection is limited to the "immediate acceptance or rejection" of the finished product. Even St. Hilaire's suggested origin of the first bird from a reptile's egg, as repeated by a recent paleontologist, is cited by Goldschmidt with seeming approval.

We should surely need the guiding hand of an entelechy here, if not the direct intervention of the Creator himself. That a single, small, genetic change can produce varied and far-reaching somatic changes no one is better qualified to tell us than Professor Goldschmidt. That somatic changes produced in this way have any necessary tendency to be functionally integrated he has not, however, shown to be probable. Yet the most casual examination of any complex organ shows that it is made up of innumerable interrelated parts, harmoniously adjusted to one another. Consider the structure of even a bird's feather! Only the wave of a magician's wand could have transformed the scales of a reptile forthright into the plumage of a bird.

The trouble here is not so much that we are concerned with very great changes, structural and functional, but that these changes must involve the harmonious modification of parts which are to a large extent independent of one another genetically. Goldschmidt's assurance that "a simple shift in the velocity of one of the integrating processes relative to the others will account for the primary change with all the later unavoidable consequences during subsequent development" may suggest a partial solution of some of the difficulties. It can hardly apply, however, to cases involving the simultaneous though not necessarily parallel, modification of different organ-systems, and particularly to the appearance of fundamentally new structures in some of these. Mivart realized the difficulty of accounting for such functional integration in a theory of evolution by "jumps" and called in a supernatural agent to help him out.

Recent biology has sometimes shown itself so unsympathetic toward the conception of "adaptation" that it has even tended to overlook the facts to which this term is applied. Darwin was largely concerned with the endeavor to explain these facts. We can not, indeed, take them for granted, unless we are prepared to abandon the search for a naturalistic explanation.

It is significant that Goldschmidt's most voluminous line of evidence for the production of major bodily changes through single genetic steps is drawn from the field of rudimentation. Under this head, he has assembled a mass of highly interesting facts. It has long been known that even a single gene mutation may result in the degradation or loss of such important structures as an insect's wings or eyes. It is, however, easy to misinterpret such facts. May I repeat a doubtless unoriginal utterance of my own on this subject: "That a single and extremely simple alteration may effect a radical change in an object, even to its complete annihilation, proves nothing as to the degree of complexity of the object itself or of the processes necessary to bring it into existence."[4]

If Professor Goldschmidt can point to any one case in which a new, complex, adaptive structure has arisen through a single genetic change, and if this same genetic change is shown to have involved the necessary correlative changes in many other parts of the body, he will have gone a long way toward proving his main contention. But he will, at the same time, have left naturalistic biology in a most embarrassing position.

F. B. SUMNER
SCRIPPS INSTITUTION OF OCEANOGRAPHY

THE ACTIVE PRINCIPLE OF MARIHUANA

FROM red oil distillates, Haagen-Smith *et al.*,[1] have reported the isolation of a crystalline product having marihuana activity. No other unmodified products possessing such activity have been isolated directly from the red oil, though it is known that synthetic tetrahydro-cannabinol possesses such activity,[2] that cannabidiol can be converted into active products by ring closure,[3] and that hydrogenated cannabinol acetate gives physiologically active products.[4]

We have subjected red oil distillates of high physiological activity to distribution between petroleum ether and methanol. This was followed by extraction repeatedly with alkali and distillation of the residue at 175–210° C (0.2 mm). Chromatographic adsorption on alumina gives a fraction (reddish-blue in ultraviolet light) which yields about 30 per cent. of crystalline 3,5-dinito-phenyl urethane. This urethane on hydrolysis gives an active product. Activities are expressed below in terms of a standard U.S.P. extract of cannabis, Parke Davis, according to procedure previously described.[5]

	Potency	Max. Dev.
Tetrahydro-cannabinol (synthetic)	10	± 3
Hydrolysate from urethane	25	± 10
A potent red oil fraction	85	± 10

[4] *American Naturalist*, March–April, 1934.
[1] Haagen-Smith *et al.*, SCIENCE, 91: 602, 1940.
[2] Adams and Baker, *Jour. Am. Chem. Soc.*, 62: 24[illegible] 1940.
[3] Adams, Pease, Cain and Clark, *Jour. Am. Chem. So[illegible]* 62: 2402, 1940.
[4] Bergel and Wagner, *Ann*, 482: 55, 1930.
[5] Walton, Martin and Keller, *Jour. Pharm. and Ex[illegible] Therap.*, 62: 239, 1938.

The urethane resembles the corresponding urethane of synthetic tetrahydro-cannabinol in solubilities, but was a higher melting point (about 216° C with reddening and gas evolution compared with that of tetrahydro-cannabinol at about 208° C with reddening and gas evolution). The analysis suggests a derivative of methyl cannabinol: C 65.12; H 6.00. The preparation could be repeated. A derivative of an active product which is possibly a tetrahydro-cannabinol has been obtained directly from the red oil.

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DESIGNATION OF LOCATIONS ON MAPS AND PHOTOGRAPHS

IN recent issues of SCIENCE, two methods of location designation have been described. One of these is a "gridiron" system,[1] the other employs "latitudes and departures."[2] Both are entirely workable within reasonable limits; neither is suitable, without some or much modification, for use with maps or photographs which are to be reproduced on a scale differing from that of the original.

A third method, which may be called a method of intersection, in which the designation remains unchanged regardless of the enlargement or reduction of the original, is here presented. Through the point to be designated and the lower left corner of the map, draw a line. Record the angle between this line and the lower margin of the map. Repeat the process with a line through the point and the lower right corner. A typical actual designation, using this system, is: *Lake Nokoni,* Rocky Mountain National Park Quadrangle, L 51½°, R 56½°. The letters R and L before the angles refer to the right and left corner angles, respectively.

It will be noted that these designations are unaltered by any change in scale of the map, through reproduction or otherwise, and that they may be used with equal facility on photographs or sketches.

RONALD L. IVES

BOULDER, COLO.

KARL FRIEDRICH GAUSS AND HIS FAMILY RELATIVES

IN this crisis of civilization the reflections of one too old for active service turn toward the history of the human progress that is now at stake. The appearance of a familiar name in the American news is a reminder of the great achievements coming from the classic ground of the Georgia Augusta at Göttingen, the famous foundation of King George the Second. In the early years of the last century a young assistant at the observatory, already a great mathematician, directed his attention to the philosophy of geodesy. He recognized that an observer at station A could make his survey of his neighborhood by use of the fixed stars as a frame of reference; while an observer at a distant terrestrial station B could likewise make a local survey, by aid of the same framework of stars now however in quite different relative position. The two observers or any set of such pairs could know nothing more about their mutual relations if they were outside each other's range of vision owing to the protuberance of the earth's curvature; unless they had the property of locomotion, and could carry measuring chains about with them. The philosophical question of the relation of the results of survey by astronomical angular observations to the results of a chain triangulation of the non-spherical surface, and the foundations required to express their mutual consistency in a single scheme impressed the attention of Gauss so far as even to entice him to undertake a practical survey in the kingdom of Hanover with that end in view. This was the beginning from which the famous mathematical theory of a surface, like that of the earth, arose, considered as a self-contained region standing by itself without any support from a frame of space such as the stars had provided in the practical geodesic problem. Building on his foundation Riemann, also at Göttingen, extended it far beyond this self-contained surface of two dimensions to cognate loci of many dimensions, in results which were made available to the public only many years later, after his premature death. And more recently the Italian geometers Ricci and Levi-Civika condensed its complications into a very remarkable system of general classification of a system of related abstract concepts. This in turn has been annexed during the last great war as a foundation for a universe of mathematical relativity, which by abolishing time and space and evading all dependence of expression of results on frames of reference, has presented a mathematical model of a concise new physical world free from observational imperfections that insisted on arising from the fact of the delay in time of transmission of influences, which is in fact necessary if there is to be any analyzable medium of transmission at all.

This digression leads to my query. Long ago the great mathematician Felix Klein, well known in America, mentioned to me that he understood that

[1] C. F. Reed, SCIENCE, 93: 68, 1941.
[2] L. Hubrecht and R. O. Erickson, SCIENCE, 93: 288, 1941.

descendants of Gauss were still alive in America; and the recent occurrence of this unusual name in diplomacy has suggested that exploration in this direction would be of interest as relating to a conspicuous illustration of the dispersal of Central European centers of learning.

JOSEPH LARMOR

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SCIENTIFIC BOOKS

THE COMPARATIVE PHYSIOLOGY OF RESPIRATORY MECHANISMS

The Comparative Physiology of Respiratory Mechanisms. By AUGUST KROGH. vii + 172 pp. 84 figures. University of Pennsylvania Press. $3.00.

IN the spring of 1939, Professor Krogh delivered a series of lectures on "The Comparative Physiology of Respiratory Mechanisms" at Swarthmore College, and these lectures have now been prepared by him in a publication of about one hundred and fifty pages. The principal theme is shown by the title. It is approached through a discussion of the quantity of oxygen needed by various organisms at rest and in activity. The maximum steady metabolism indicates the maximum capacity of the animal's respiratory apparatus. Oxygen is available in the air and water at tensions differing according to the particular environment, and it is the difference between the tension in the environment and at the metabolizing tissues which determines the force available for diffusion in the respiratory exchange.

The external exchange is effected in special devices like gills and lungs, which secure the exchange in many different structures suited to the various animals, their habitat and activity. Special requirements, like heavy work or the restricted supply of oxygen during diving, show the adjustments of respiration under stress.

The blood of animals shows that there are several different chemical mechanisms utilized to facilitate transfer to the respiring tissues. The final transfer of oxygen and carbon dioxide between blood and tissues is related to the distribution and regulation of the capillary circulation, but the details for this last step in the respiratory exchange are still obscure.

The tracheal respiration of insects has particularly interested Professor Krogh. He develops this subject in detail, presenting many descriptions of analyses of the mechanisms involved which originate from his own laboratory, or as a result of his suggestions. There are so many intricate variations in the organs and methods of tracheal respiration, and Professor Krogh's knowledge and appreciation of them is so precise that this is one of the most interesting chapters of the book.

The book is written in a very succinct style, and the examples and illustrations are clear and appropriate. Printing, illustration and arrangement have been very nicely done. Each detail of the exposition is presented separately and distinctly, but the order of material and the brief conclusions always lead toward the complete picture of respiration suited to maintain the animal at its own level of activity and in its own environment.

LAURENCE IRVING

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ULTRAVIOLET RAYS

The Chemical Action of Ultraviolet Rays. By CARLETON ELLIS and ALFRED A. WELLS. ix + 961 pp. Illus. New York: Reinhold Publishing Corporation. 1941. $12.00

PHOTOCHEMISTRY, more than most branches of physical chemistry, has suffered from the fact that guiding principles and accurate experimental methods have been slow in their development. This is due partly to the fact that many chemists have been inadequately trained in the use of the physical methods necessary for prosecution of sound research work in this field and partly because of the very complexity of the subject itself. During recent years, however, much progress has been made, and to-day there is a growing appreciation of the importance of the study of the effects of electromagnetic radiation both from the standpoint of the pure chemist and of the biologist.

"The Chemical Action of Ultraviolet Rays" is an attempt to provide a comprehensive survey of the effects of visible and ultraviolet light on chemical systems. A glance at the chapter headings will indicate the breadth of the subject covered. Experimental methods, quantum theory, spectroscopy, photochemical reactions, applications to industrial products and applications in biology are all treated. The number of literature references runs into the thousands.

Any book which attempts to cover as much ground as this one will necessarily be open to several criticisms. The uninitiated would have some difficulty in learning much about theories of spectroscopy and of reaction kinetics from a treatment as brief as the one given, but the list of references on experimental methods is very valuable.

The authors have done a real service to photochemists in covering the literature very thoroughly. One will find cited all the important references on nearly all reactions which have been shown to be light sensitive. The reader will thus be able to ascertain many of the facts in this field. It would be much more difficult for him to obtain a clear idea of the mechanisms

of the reactions which are discussed. Photochemistry has been beset by apparent conflicts in experimental results more than most branches of chemistry. This is due to difficulties in experimental technique and to a lack of appreciation of all the variables which can effect the course of a photochemical reaction. The chief criticism of this book lies in the fact that most of the data are presented without an adequate attempt at critical evaluation. This leads all too often to the feeling that there are unresolvable differences of opinion in the interpretation of the data.

The parts of the book which deal with the biological effects of radiation are useful. Much of this material seems never to have been brought together in one place before. Lethal action, therapeutic effects, rickets and Vitamin D, and photosynthesis are among the subjects covered.

"The Chemical Action of Ultraviolet Rays" should be extremely valuable to any worker who wishes a handy reference book covering the field comprehensively. As already indicated any such comprehensive survey of the literature of a field is always of service.

W. ALBERT NOYES, JR.

UNIVERSITY OF ROCHESTER

SOCIETIES AND MEETINGS

NORTH CAROLINA ACADEMY OF SCIENCE

THE fortieth annual meeting of the North Carolina Academy of Science was held at Chapel Hill on April 25 and 26. The meeting was unusually well attended and an exceptional program was provided. The peak of attendance was approximately 300 and more than 80 papers were presented in the various scientific fields. The North Carolina Section of the American Chemical Society met at the same time and place with probably 75 attending to hear the 15 papers offered.

An innovation at the meeting was the setting aside of a definite time for demonstrations. This proved very successful for papers which were presented formally, as well as for those which consisted of the demonstration only.

The Poteat award was conferred on Miss Alma Whiffen, of the University of North Carolina, for her paper on "The Role of Chytrids in Cellulose Decomposition." The American Association grant for research went to Drs. C. H. Lindsley and N. Rosen for a study of the "Zeeman Effect in the Palladium Spectrum." Mr. John M. Stewart, a student of the Alamance High School, was awarded the project prize of $20.00, while the forestry essay prize of $20.00 was divided between William Anderson, of the Hayesville High School, and Omega Rice, of the Dorland-Bell School at Hot Springs.

A meeting was held for high-school teachers and sponsors of high-school science clubs. A program of especial interest to them was provided.

The university gave the academy a dinner, which was followed by the address of the president of the academy, Dr. J. L. Stuckey, on "Man and Minerals." The Elisha Mitchell Scientific Society entertained the academy after the address.

The committee reports were presented in mimeographed form, and these along with the treasurer's preliminary report was adopted. The secretary reported that about 80 members had been added to the roll during the year.

The following officers were elected for the ensuing year: *President,* R. E. Coker, of the University of North Carolina; *Vice-President,* C. N. Warfield, of the Woman's College of the University of North Carolina; *Secretary-Treasurer,* B. Cunningham, of Duke University (continues); *New Member of the Executive Committee,* D. B. Anderson, North Carolina State College; *New Members of the Research Grants Committee,* C. F. Korstian, Duke University, and J. N. Couch, of the University of North Carolina.

A more detailed report of the meeting will appear in the *Journal of the Elisha Mitchell Scientific Society.*

BERT CUNNINGHAM,
Secretary

SPECIAL ARTICLES

THE BIOTIN CONTENT OF TUMORS AND OTHER TISSUES

THE search for significant differences between the metabolism of normal and malignant cells has long occupied the attention of those concerned in a biochemical approach to the tumor problem. Of particular interest in this respect are substances of vitamin or enzyme nature, which in relatively minute amounts exert powerful regulatory influences on the growth of tissues. One of the more recently studied and most active of these compounds is biotin, or vitamin H, which is already known to be essential for the vital functions of many micro-organisms[1,2,3,4,5] and higher

[1] F. Kögl and B. Tonnis, *Zs. phys. Chem.*, 242: 43, 1936.
[2] P. M. West and P. W. Wilson, *Enzymologia,* 8: 152, 1940.
[3] R. Nilsson *et al., Ann. Landw. Hochschule Schwedens,* 7: 301, 1939.
[4] E. E. Snell and R. J. Williams, *Jour. Am. Chem. Soc.,* 61: 3594, 1939.

animals.[6,7] In the present note some preliminary observations on the relative abundance of this growth factor in various tissues are presented, without any attempt to suggest the possible implications of such findings.

Assays for total biotin were made on acid-hydrolyzed tissues by a microbiological method based on the specific requirement of *Rhizobium trifolii* (Wisconsin strain 205) for this factor.[2,3] Details of the procedure will appear elsewhere. Results are expressed in terms of pure biotin, by standardization of the method with the crystalline methyl ester kindly supplied us by Dr. Vincent du Vigneaud.

Since embryos share with most tumors the property of rapid growth it was of interest, before proceeding with an analysis of the latter, to discover whether or not embryonic organs differ appreciably in biotin content from the corresponding structures in the adult. The levels for the same organ from several different adult Wistar rats on a stock laboratory ration were found to be remarkably uniform. Individual organs of the same animal, however, differed widely in the amount of growth factor contained, each apparently possessing an amount peculiar to itself. With a series of biotin values for normal rat organs established, estimations were made on full-term rat embryos and the results compared. The following data, expressed in micrograms of biotin per gram of dried tissue, are typical of several experiments:

Skin:	adult	84 mγ;	embryo	1061 mγ
Muscle:	"	191 " ;	"	2150 "
Lung:	"	289 " ;	"	1350 "
Brain:	"	772 " ;	"	1945 "
Heart:	"	1890 " ;	"	1610 "
Kidney:	"	2273 " ;	"	707 "
Liver:	"	3393 " ;	"	2030 "

It will be seen that in the embryo, skin and skeletal muscle, which make up the greater part of the total body weight, contain amounts of biotin greatly in excess of those found in the corresponding adult organs. Lung and brain present a similar contrast, the data for the four together suggesting that in association with the rapid growth of the embryo there are increased demands for biotin. Heart, kidney and liver, however, which in the adult are notably rich in biotin, show lower levels in the embryo. This we can not explain at present, but it seems possible that in the adult these tissues represent storage depots, thereby complicating a comparison of this kind.

The types of tumor suitable for biochemical study are decidedly limited by the difficulty of obtaining satisfactory normal control tissues. The ideal materials would be a tumor involving only a single variety of cell and a corresponding normal tissue of similar purity and cellularity. A neoplasm approaching these requirements is the Shope rabbit papilloma. By careful dissection it is possible to obtain normal adult rabbit skin as a control which, although not pure epithelium, nevertheless on microscopic examination was found to contain no more connective tissue than the tumor. Analysis of such materials yielded the following results:

Domestic rabbit:	adult	skin	98 mγ;	papilloma	396 mγ
"	" :	"	"	63 " ;	"	300 "
Wild	" :	"	"	119 " ;	"	458 "
"	" :	"	"	178 " ;	"	440 "

Domestic rabbit embryo skin was assayed for comparative purposes and found to contain 531 mγ biotin per gram in contrast to a level of 14 mγ in the skin of the mother.

Other tumors of epithelial origin, obtained from human sources, have also been found distinctly richer in the growth substance than adjacent normal tissue. In carcinomas of the gastro-intestinal tract the controls consisted of normal mucous membrane dissected away from underlying tissues; in carcinomas of the lung, normal lung had to be used, though it is admittedly not so suitable a control as those for the other tumors. Examples of representative assays are:

Carcinoma	of sigmoid	787 mγ;	control	284 mγ
"	" rectum	444 " ;	"	102 "
"	" lung	502 " ;	"	151 "
"	" lung	352 " ;	"	145 "

The figures for 4 bone sarcomas averaged 202 mγ as against 1.2 mγ per gram of organic matter from the adjoining normal bone, but we are sceptical as to the value of these findings since the neoplasms were so much more cellular than the mother tissue.

All diagnoses were confirmed microscopically.

Primary carcinoma of the liver, readily induced in rats by feeding p-dimethylaminoazobenzene,[8] is a tumor well suited to biochemical study. In such animals the biotin level of the liver adjacent to the neoplasms was found to be normal, while the carcinomas themselves, unlike the other tumors examined, were decidedly poorer in this factor; *e.g.*, controls 3671 and 3190 mγ, tumors 1905 and 812 mγ of biotin, respectively. This discrepancy can not be explained by the presence of necrosis, for all visible necrotic material was removed.

It seems significant that in every case studied the biotin level of the tumor deviated sharply from the normal adult values in the same direction as that of the corresponding embryo tissues. One might ask whether this result represents a difference in metabolism shared by tumor and embryo, or whether it represents a change common to all tissues in which cells

[5] J. R. Porter and M. J. Pelczar, *Jour. Bact.*, 41: 173, 1941.

[6] P. György, *Jour. Biol. Chem.*, 131: 733, 1939.

[7] P. György, *et al.*, SCIENCE, 91: 243–245, 1940.

[8] Riojun Kinosita, *Trans. Soc. Path. Japonicae*, 27: 665, 1937.

re actively dividing. The former seems more likely present, for the biotin content of rat liver vigorously regenerating after partial hepatectomy,[9] or of the pregnant human uterus, was found not to differ from that of the same tissues in a non-hyperplastic state.

We are indebted to the following gentlemen for a generous supply of material: Drs. Robert P. Hill, James W. Jobling, Homer D. Kesten, John G. Kidd, Richard E. Shope, Charles M. Steer, Fred Stewart, Arthur Purdy Stout and Benjamin P. Watson.

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THE PRESERVATION BY FREEZING AND DRYING IN VACUO OF THE MILK-INFLUENCE FOR THE DEVELOPMENT OF BREAST CANCER IN MICE[1]

THERE is an active influence in the milk of lactating females of strains of mice having a high incidence of carcinoma of the mammary glands which promotes the development of this type of cancer.[2] This influence is usually obtained by nursing but may also be transferred by the transplantation of splenic tissue[3] and by the feeding of milk secured from females of cancerous strains. The milk was given to animals after they had been weaned.[4] The amount of milk given may have influenced the incidence and the average age at the time of the appearance of the tumors. Macerated liver from mice of cancerous strains failed to affect the incidence of breast tumors.

This report considers the feeding of lyophilized tissue of spontaneous mammary carcinoma. The tissue was prepared by Dr. G. Burroughs Mider, research fellow, National Cancer Institute, while at the University of Rochester, as follows: The spontaneous tumors were removed under aseptic conditions, finely minced with a knife and placed in tubes. The tissue was frozen immediately at −72° C. and dried *in vacuo*. At the completion of the process the tubes were sealed with a blow torch.

Thirty cc of water was added to 10 cc of the lyophilized tumor-tissue and filtered (filter paper). The filtrate was placed before the mice in small dishes: 10 cc for each 5 mice or 2 cc per mouse. The animals had been without water for about 18 hours.

The mice which received the filtrate were representatives of the Ax strain[2, 5, 6] and were from 4 to 5 weeks of age. The mice of this line are descended from a female (No. 38432) of the A strain which had been fostered from birth by a female of the CBA or X stock (low breast cancerous strain). The incidence of breast cancer in breeding females of the Ax strain has been 3.1 per cent. (292 mice), average tumor age 13.9 months and average non-tumor age 17.2 months. Over 90 per cent. of the breeding females of the A stock develop mammary cancer,[5, 6] whereas few (4.9 per cent.) of the females of the A strain kept as virgins became cancerous.[7]

Six of the 10 mice of the Ax strain which consumed the filtrate of the lyophilized tumor-tissue have developed breast tumors (12.4 months), one was missing at 12 months of age and three are living at 17.5 months. These mice were used as breeders.

DISCUSSION

As has been reported the females of the Ax strain are genetically of a constitution in which breast tumors may be expected to develop if they are nursed by females which have the active influence in their milk and are used as breeders.[8]

The ten experimental animals were the progeny of three females. Two of the three mothers have had other progeny which have been continued as breeders, and they and their descendants number 24 mice. As none of these mice has developed breast tumors it is improbable that the mice which received the filtrate of the lyophilized tissue were subjected to an active influence in the milk of their maternal parent or that the influence developed *de novo*.[5]

The voluntary method of feeding the material did not insure that each mouse consumed the same amount, as some might have taken very little. Whether or not the age of the animals at the time they developed tumors may indicate the amount taken is problematical, as great age differences in the time of tumor development are also common among the controls, even for mice of the same litter.

The technique used in the preparation of the lyophilized tumor-tissue was similar to that described by others to preserve the viruses of other diseases.[9] Thus, the results obtained in the present experiment with a small number of animals suggest that the active influence in the milk of females of strains of mice having a high incidence of breast cancer may be a virus.

SUMMARY

The development of spontaneous breast cancer in

[9] George M. Higgins and Reuben M. Anderson, *Arch. Path.*, 12: 186, 1931.
[1] Preliminary report.
[2] J. J. Bittner, SCIENCE, 84: 162, 1936. Reviewed in footnote 8.
[3] *Idem, Pub. Health Rept.*, 54: 1827, 1939.
[4] *Idem, Proc. Soc. Exper. Biol. and Med.*, 45: 805, 1940.
[5] *Idem, Cancer Research*, 1: 113, 1941.
[6] *Ibid.*, 1: 115, 1941.
[7] J. J. Bittner, *Pub. Health Rept.*, 54: 1113, 1939.
[8] *Idem, Jour. Nat. Cancer Inst.*, 1: 155, 1940.
[9] J. G. Wooley, *Pub. Health Rept.*, 54: 1077, 1939.

mice following the feeding of lyophilized tissue prepared from breast tumors suggests that the active influence usually transferred in the milk by nursing may be a virus.

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A PROBABLE AGENT FOR THE TRANSMISSION OF FOWL PARALYSIS

FOWL paralysis, sometimes called "range paralysis," is a disease that is widespread in this country. In many instances the toll is heavy. The disease made its appearance at this college in 1937, causing 61 deaths in a flock of 225 chickens. In 1938 a flock of 345 birds had 92 fatalities. In 1939 three flocks with a total of 439 birds had 403 fatalities.

The fatalities in 1939 occurred from May 10 to September 28. An old barn infested with "blue bugs," *Argas persicus* (Oken) (*A. miniatus* Koch), stood near the pens, and the chickens were practically all infested when the large number of fatalities occurred. This led one of the authors (Brown) to suspect the "blue bugs," or fowl ticks, as being associated with the disease. Immediately experiments were started to see if the suspicion was justifiable. The barn was torn down and the hen houses were disinfected with carbolineum.

On September 2, 1939, twelve pens heavily infested with "blue bugs" were divided into two groups of six pens each. In group I six birds with paralysis were placed in each pen on September 4. On September 9 twelve birds without paralysis were placed in the six pens with the thirty-six paralyzed birds. The paralyzed birds were removed from the pens on September 21. Twenty-one days after being placed in the pens the well birds began to show paralysis. On the thirty-first day all were down with paralysis.

The six pens of group II were thoroughly disinfected with carbolineum on September 5. Six pullets were placed in each of the six disinfected pens on September 9. These pens were disinfected again on September 12. These pens were used as controls, and no paralysis occurred after they had been occupied for 31 days.

Similar experiments to the one outlined above were repeated five times over a period of one year, with the exception that no paralyzed birds were introduced. Some were kept in pens infested with "blue bugs," while others were kept as controls in pens free from these parasites. In the pens infested with the "blue bugs" 111 birds out of 120 developed paralysis. In the control pens 1 bird out of 126 developed paralysis.

[10] Assisted by a grant from the National Cancer Institute.

On September 1, 1940, five hens were placed in one of the infested pens. When paralysis had appeared (September 27), one of the hens was taken to the laboratory where the young "blue bugs" were removed from the hen, treated with 50 per cent. ethyl alcohol, removed to a sterile physiological salt solution, and ground until a suspension was made of their body contents. This suspension was injected into three young birds—two cockerels and one pullet. These birds were placed in a clean pen free from "blue bugs." Between the twenty-first and the twenty-fifth day the cockerels broke down with paralysis; the pullet broke down on the twenty-ninth day. On November 1 a two-year-old hen and a pullet were injected with some of the same suspension (34 days after making it). On November 29 the pullet was prostrate. The hen was paralyzed in one leg. In the main breeding yards of the college only five chickens with paralysis have been found since September, 1939, following intensive work to prevent the recurrence of "blue bugs."

The results given here indicate that the "blue bugs," *Argas persicus,* are agents for transmitting fowl paralysis. Other parasites may be agents also, but in this preliminary report the authors have data for only the one. Further experimentation on an extensive scale is now being planned.

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BOOKS RECEIVED

ARENSON, SAUL B. *Chemical Arithmetic.* Second edition. Pp. 130. Wiley. $1.50.

CHANEY, RALPH W. and HSEN HSU HU. Carnegie Institution of Washington, *Publication No. 507; A Miocene Flora from Shantung Province, China.* Pp. 147. 5 plates. The Institution. $3.25.

CHILD, C. M. *Patterns and Problems of Development.* Pp. ix + 811. 224 figures. University of Chicago Press. $8.00.

FIESER, LOUIS F. *Experiments in Organic Chemistry.* Second edition. Pp. x + 487. 80 figures. Heath. $2.80.

GRAY, GEORGE W. *Education on an International Scale; A History of the International Education Board, 1923–1938.* Pp. xiii + 114. Illustrated. Harcourt, Brace. $2.00.

HODGE, W. V. D. *The Theory and Applications of Harmonic Integrals.* Pp. ix + 281. Cambridge University Press, Macmillan. $4.50.

HURLBURT, CORNELIUS S., JR., Editor. *Dana's Manual of Mineralogy.* Fifteenth edition, revised. Pp. i–480. 436 figures. Wiley. $4.00.

MILLER, FREDERIC H. *Partial Differential Equations.* Pp. ix + 259. 15 figures. Wiley. $3.00.

PAVLOV, IVAN P. *Conditioned Reflexes and Psychiatry.* Translated and edited by W. HORSLEY GANTT. Pp. 199. International Publishers, New York. $4.00.

WOODRUFF, LORANDE L. *Foundations of Biology.* Sixth edition, revised. Pp. xvii + 773. 469 figures. Macmillan. $3.75.

WORTHEN, EDMUND L. *Farm Soils; Their Management and Fertilization.* Third edition, revised. Pp. xiii + 515. 226 figures. Wiley. $2.75.